SECTION 23 - TECHNICAL SPECIFICATION FOR TRAFFIC SIGNALS

23-1.1 DEFINITIONS

Wherever in the Special Provisions and other contract documents the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as follows:

Electrical Superintendent: City of Fresno Traffic Signals and Streetlights Supervisor or his representative.

Engineer: Construction Management Engineer or his representative.

Traffic Engineer: City Traffic Engineer or his representative.

Standard Specifications: State of California Department of Transportation, Standard Specifications, latest edition.

Traffic Signal Poles/Standards: State of California, Department of Transportation, Standard Specifications, 1997 Edition. (113 km rating/70 mph rating)

23-1.2 GENERAL

Furnishing and installing traffic signals and highway lighting and payment therefore shall conform to the provisions in Section 86, "Signals, Lighting and Electrical Systems," of the State of California, Department of Transportation Standard Specifications and the Standard Plans, latest edition, City of Fresno Standard Drawings, Special Provisions and the Plans.

Signals and Lighting work is to be performed at the locations shown on the plans.

Existing electrical systems, or approved temporary replacements thereof, shall be kept in effective operation during the progress of the work, except when shutdown is permitted.

Work or equipment not specified or shown on the plans which is necessary for the proper operation of the traffic signal in this section shall be provided and installed at no additional cost to the City.

The locations of foundations, standards, services, pull boxes and other appurtenances shown on the plans are approximate. Exact locations and grades will be established as necessary by either the Traffic Engineer and/or Engineer in the field.

23-1.3 MATERIALS

Attention is directed to Section 6, "Control of Materials," of the Standard Specifications and these Special Provisions.

All materials required to complete the work under this contract shall be furnished by the Contractor, except as noted in the following paragraph 23-1.4, "City-Furnished Materials".

The materials furnished and used shall be new, except such used materials as may be specifically provided for on the plans.

All work and materials shall be in full accordance with the latest rules and regulations of the National Board of Fire Underwriters, and local ordinance or State laws, the State of California Industrial Accident Commission's Safety Orders, and Regulations of the Pacific Gas and Electric Company pertaining to service equipment and installations thereof. All work shall comply with Fresno City Electrical Ordinances and National Electrical Manufacturer's Association Standards and all regulations and codes as stated in Section 86-1.02 "Regulations and Codes" of the Standard Specifications. Nothing in these plans and specifications shall be construed to permit work not complying with these codes.

23-1.4 CITY-FURNISHED MATERIALS

Attention is directed to Section 6-1.02, "State-Furnished Materials," of the Standard Specifications and these Special Provisions.

Unless otherwise provided in this section, the Contractor shall submit a written request to the Traffic Engineer for the delivery of City-furnished material at least 15 days in advance of the date of its intended use. The request shall state the quantity and type of each material.

The Contractor shall pick up the City-furnished equipment, if any, from the City of Fresno, Street Maintenance Division, 2101 'G' Street, Bldg. "E", Fresno, California. Contact Electrical Superintendent at least two working days prior to picking up the material. The contractor is responsible for providing adequate loading means.

23-1.5 EQUIPMENT LIST

Equipment list and drawings shall conform to the provisions in Section 86-1.04 and these Special Provisions.

All equipment and materials that the Contractor proposes to install shall conform to these specifications and the contract plans. A list of substitute equipment and/or materials, along with a written descriptive summary, describing the functions of the components which the Contractor proposes to install shall be submitted along with his bid proposal. The list shall be complete as to the name of the manufacturer, size and identifying number of each item. The list shall be supplemented by such other data as may be required.

In all cases, the judgment of the Electrical Superintendent shall be final as to whether substitute equipment and/or material recommended by the Contractor conforms to the intent of these specifications and is acceptable for use.

23-1.6 WARRANTIES, GUARANTEES AND INSTRUCTION SHEETS

Warranties, guarantees and instruction sheets shall conform to the provisions in Section 86-1.05, "Warranties, Guarantees and Instruction Sheets," of the Standard Specifications and these Special Provisions.
All equipment furnished shall be guaranteed to the City by the manufacturers for a period of not less than one (1) year, unless otherwise indicated, following the date of acceptance of the signal installation of such equipment. If any part (or parts) is (are) found to be defective in materials or workmanship within the one-year period, and it is determined by the Electrical Superintendent, or by an authorized manufacturer's representative that said part (or parts) cannot be repaired on the site, the manufacturer shall provide a replacement part (or parts) of equal kind and/or type during the repair period and shall be responsible for the removal, handling, repair or replacement and reinstallation of the part (or parts) until such time as the traffic signal or street lighting equipment is functioning as specified and as intended herein; the repair period shall in no event exceed 72 hours, including acquisition of parts.

The one-year guarantee on the repaired or replaced parts shall again commence with the date of reassembly of the system.

All work done by the Contractor shall be guaranteed in writing to the Engineer for the 12 months from the date of acceptance.

23-1.7 MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS

The Contractor shall notify the Engineer at least one full working day (not less than 24 hours) prior to the shutdown of any traffic signal and lighting system. The Contractor may use temporary splices and wiring as approved by the Engineer to maintain existing and temporary traffic signal and lighting systems. Shutdowns of traffic signal and lighting systems shall be limited to the period from 9 a.m. to 4 p.m. of normal working days, excluding legal holidays, weekends, and non-working days as determined by the Engineer.

23-1.8 SCHEDULING OF WORK

Scheduling of work shall conform to the provisions in Section 86-1.07, "Scheduling of Work" of the Standard Specifications and these Special Provisions.

The Contractor shall notify the Engineer at least one working day in advance of any electrical work and also at least one working day in advance of any work done intermittently to facilitate inspection.

23-1.9 FOUNDATIONS

Foundations shall conform to the provisions in Section 86-2.03, "Foundations," of the Standard Specifications and these Special Provisions.

Portland cement concrete shall conform to Section 90-10, "Minor Concrete," of the Standard Specifications and shall contain not less than 470 pounds of cement per

cubic yard, except concrete for reinforced pile foundations shall contain not less than 564 pounds of cement per cubic yard.

Foundation concrete shall be placed in a single pour except that pouring of the top six inches may be postponed when prior approval has been obtained.
Exact location for controller cabinet shall be designated by the Traffic Engineer and approved by Electrical Superintendent, 48-hour notice required.

No utilities shall be permitted to run through any foundations.

PVC wire-ways shall be installed as detailed in Public Works Standard Drawings E-27. Foundations shall be poured against undisturbed earth where practicable. The exposed portion shall be formed and finished to present a neat appearance. Where obstructions or other conditions prevent construction of planned foundations, the Contractor shall construct an effective foundation satisfactory to the Engineer.

The bottom of concrete foundations shall rest on firm ground. When placing the foundations, the Contractor shall place all conduit ends in their proper position, at the correct heights and shall securely hold them in position during the pouring of concrete. Conduit shall be capped before any concrete is poured. Both forms and earth to be in contact with foundations shall be thoroughly moistened before placing concrete.

Anchor bolts shall be galvanized and shall extend above the finished base as needed to insure a minimum extension above the top nut of 3 threads. The maximum extension above the top nut is 1 inch. Each bolt shall be supplied with 2 nuts and 2 flat washers to facilitate leveling. The distance between the bottom nut and the top of the finished foundation shall vary depending on the diameter of the anchor bolt being used. For anchor bolts 1" or less in diameter this distance is 1" minimum and 1-1/2" maximum. For anchor bolts greater than 1" in diameter the distance is 1-1/2" minimum and 2" maximum.

The anchor bolts and conduits shall be held in place by means of a template until the concrete sets.

Poles, standards and pedestals shall not be erected until the foundation concrete has set at least seven days and shall be plumbed or raked as directed by the Engineer. Top of concrete foundations shall be finished relative to curb or sidewalk grade or as shown on the plans or as directed by the Engineer.

Locations shown on the plans are schematic.

The top of controller cabinet foundation shall be 12-inches above the surrounding grade or sidewalk.

23-1.10 STANDARDS, STEEL PEDESTAL AND POSTS

Standards, steel pedestals and posts shall conform to the provisions in Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Standard Specifications and these Special Provisions.

If relocation of utilities is required, immediate notification shall be given to the appropriate utility company by the Contractor.

The Contractor may install all underground electrical components, including foundations for signal standards and controller cabinet at the site of the project; however, no traffic signal standards shall be erected until all controlling equipment is available to the Contractor for installation.
All nuts, washers, screws and other post hardware shall be galvanized.

23-1.11 CONDUIT

Conduit shall conform to the provisions in Section 86-2.05, "Conduit", of the Standard Specifications and these Special Provisions.

Nonmetallic-type conduit shall not be used, unless specifically called for on plans. Wire-ways and conduits between standards and adjacent pull boxes shall be PVC per City of Fresno Standard Drawing E-6.

Conduit shall be of rigid type, conforming to Article 346 of the National Electrical Code. All conduit and fittings shall be hot dip galvanized. Each length shall bear the labels of Underwriters Laboratories, Inc. Installation shall conform to appropriate Articles of the Code.

All couplings shall be tightened to provide a good electrical and mechanical connection throughout the entire length of the conduit run. The use of threadless or set screw fittings is not allowed. No running threads are permitted.

Conduit threads and damaged conduit surfaces on metal conduit shall be thoroughly painted with zinc rich paint conforming to Military Specification DOD-P-21035A.

All conduit ends shall be threaded and capped with standard conduit caps until wiring is started. When the caps are removed the threaded ends shall be provided with approved insulated hot dipped galvanized malleable iron bushings. All bushings in pull boxes, controller or service pedestal shall have lay-in style copper lugs provided for bonding. Non-copper lay-in style lugs that are cast integral with the bushing are also acceptable.

It shall be the privilege of the Contractor, at his own expense, to use larger size conduit if desired, and where larger size conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted.

All conduit shall be laid to a depth of not less than twenty-four inches nor greater than thirty-six inches below the curb grade in the sidewalk areas and from the finished surface in street areas. Conduits in sidewalk areas parallel to the curb shall not be installed more than twenty-four inches from inside of curb line toward property line.

Conduit shall be placed under existing pavement by directional boring and jacking method. Pavement shall not be disturbed without the written permission of the Engineer and then only in the event insurmountable obstructions are encountered. Excessive use of water, such that pavement might be undermined, or subgrade softened, will not be permitted.
Conduit in pull boxes shall not extend more than two inches inside the box wall. No conduit may enter the pullbox from the bottom unless approved by the Engineer. No conduit or utility shall pass through a signal, controller or street light base or pull box

except the conduit which terminates within the base or pull box.

Bushings shall be required on any PVC conduit greater than 1" trade size.

After the installation of all conductors and cables, the ends of conduits terminating in pull boxes, the controller cabinet and service pedestal shall be sealed with an approved duct seal material. In as much as possible, conduit shall be run in a straight line from one pullbox or pole to the next, maintaining a consistent setback from the curb. Any variation from this requirement shall be approved by the Engineer.

23-1.12 PULL BOXES

Concrete pull boxes shall conform to the provisions in Section 86-2.06, "Pull Boxes," of the Standard Specifications and these Special Provisions.

All pull boxes shall be No. 5 unless otherwise noted on the plans. See Caltrans Section 86-2.06 and City Standard Drawing E-4 regarding requirements for grouting, drain hole, etc.

All pull boxes shall be installed with extensions.

The pull box lid adjacent to Pacific Gas & Electric Company's service pole shall be marked "PG&E." All others shall be inscribed "Traffic Signal", “Interconnect” or "Street Lights" as appropriate.

Pull boxes on long runs shall be installed and spaced at not over 200-foot intervals, and shall be required in all conduit change of directions.

No. 6 pull boxes shall be installed with fibrelyte lids.

All pull boxes shall be wrapped with building paper prior to backfilling. When the pull box is installed in a non- sidewalk area, install a formed concrete apron, 1-foot wide and 4 inches deep around the pull box. The apron shall be sloped to drain away from the pull box.

Concrete fiber optic vaults shall be a PTS-4878 and inside dimensions of 48"x78"x48". Covers shall be a hinged, torsion assisted steel and shall be inscribed "INTERCONNECT” with welded 1-1/2" letters. Vaults shall be placed on a 12" base of crushed rock.

All mounting hardware shall be galvanized, plated or stainless steel. Cover assisted springs shall be coated with a corrosion resistant finish.

23-1.13 CONDUCTORS AND WIRING

Conductors and wiring shall conform to the provisions in Section 86-2.08, "Conductors," and Section 86-2.09, "Wiring," of the Standard Specifications and these Special Provisions.

All 7-conductor, 5-conductor and 3-conductor cables shall conform to the latest International Municipal Signal Association (IMSA) Specification 20-1. The cable

conductors shall be 14 AWG solid copper.

When cables are pulled into the conduit, all ends of the cables shall be taped to exclude moisture, and shall be so kept until connected to terminals.

A minimum of three feet of slack in each single conductor and cable run shall be left at each signal or lighting standard and in each pull box.

No splices shall be allowed in multi-conductor cables. They shall run from the controller terminal strip to the appropriate TS-4 terminal block. Delete the paragraph under number 5 in Section 86-2.09D "Splicing" which permits splicing of underground conductors.

All single conductor wire shall be of stranded construction with THWN type insulation. All conductors shall have insulation colors appropriate to their use and all applicable codes. The use of colored phase tape is not allowed.

Splices in single conductor wire shall be limited to the load side of the service pedestal breakers and to tap type splices located in pull boxes. These splices shall be made using either split bolts or c-tap connectors. The c-taps shall be properly sized for the wires being joined and installed with the proper tooling. The splice shall be insulated as follows: minimum 2 layers of rubber tape, 1 layer--½ lapped plastic tape, 1 layer friction tape and then coated with an approved electrical sealing compound.

Pedestrian push button circuits shall utilize a 3-conductor cable between the controller and a pedestrian TS-4 terminal assembly. The individual buttons shall be connected to the terminal assembly using DLC. Reference Public Works Standard Drawing E-20.

Conductors within the 3, 5 and 7 conductor cables shall be connected within the terminal assemblies as shown on the "Terminal Location," Public Works standard drawings E-19 and E-20.

The single conductor #14 AWG THWN copper wire installed between the TS-4 terminal block and the individual signal heads terminal block shall be terminated as follows. At the signal head end, it will be installed using a insulated spade terminal properly sized for the wire and the screw. The terminal shall be installed using the proper tooling. At the terminal assembly end, the wire shall be stripped, twisted neatly and soldered prior to installation into the box type pressure connector.

All multi-conductor cable conductors shall be terminated at the controller using the spade terminals. Terminals are available from the Traffic Signals and Streetlights Shop upon request.

The lugs used to connect with controller field terminals shall be soldered after being properly crimped. Soldering shall be by means of an iron or gun. No open flame torch may be used.

Coaxial Cable shall be 75 ohm with 20ga. Solid bare copper conductor (9.9 ohms/m). Solid polyethylene insulating dielectric, 96% (min) tinned copper double braided shield, and black polyethylene outer covering.

A minimum of 2" of slack in each coaxial cable run shall be left in the terminating junction box. A minimum of 4 feet of slack in each coaxial run shall be left in the controller cabinet.

No splices shall be allowed in coaxial cables. The cables shall run continuously from the controller to the appropriate terminating junction box.

Optical Detector Cable shall meet the requirements of IPCEA-S-61-402/NEMA WC5, Section 7.4, 600 volt control cable, 75°C., Type B, and the following:

a) The cable shall contain 3 conductors, each of which shall be No. 20 (7x28) stranded, tinned copper with low-density polyethylene insulation.

   Minimum average insulation thickness shall be 25 mils. Insulation of individual conductors shall be color coded: 1-yellow, 1-blue, 1-orange.

b) The shield shall be either tinned copper braid or alluminized polyester film with a nominal 20 percent overlap. Where the film is used, a No. 20 (7x28) stranded tinned, bare drain wire shall be placed between the insulated conductors and in contact with the conductive surface of the shield.

c) The jacket shall be black polyvinyl chloride with a minimum rating of 600 volts and 80° C (176°F) and a minimum average thickness of 45 mils. The jacket shall be marked as required by IPCEA/NEMA.

d) The finished outside diameter of the cable shall not exceed 10 mm (0.35 inch).

e) The capacitance, as measured between any conductor and the other conductors and the shield, shall not exceed 48 picofarads per foot at 1,000 Hz.

f) The cable run between each detector and the controller shall be continuous without splices or shall be spliced only as directed by the detector manufacturer.

23-1.14 FUSED SPLICE CONNECTORS

Each luminaire shall be fused with a 5 amp KTK type fuse installed in a TRON HEB type fuse holder. The fuse and holder shall be located in the pole adjacent to the hand hole.
Sufficient slack shall be provided to allow easy changing of the fuse as needed. The fuse holder shall be crimped to the wire and the crimp joints insulated as described above for tap type splices.

23-1.15 BONDING AND GROUNDING

Bonding and grounding shall conform to the provisions in Section 86-2.10, "Bonding and Grounding," of the Standard Specifications and these Special Provisions.

Ground will be obtained by installation of a ground rod within the service pedestal foundation. This ground rod shall be bonded to all metallic conduits within the

controller and all pull boxes shall be bonded in a similar manner. Within the service pedestal, controller cabinet and pull boxes adjacent to signal standards, one end of the solid #8 bonding conductor shall be extended to and attached to the pedestal, controller cabinet or signal standard using the grounding point as furnished. For signal standards not supplied with a hand hold, the grounding conductor shall be terminated on an anchor bolt between two washers installed above a leveling nut.

All ground connections shall be left visible and accessible until the final acceptance inspection is complete.

To insure proper ground distribution, a #8 stranded copper conductor with green THWN insulation shall be installed in all metallic conduits. The ends shall be attached to the bonding jumper at each end using split bolt or c-tap splices.

If a stranded #8 grounding conductor is used, it shall be attached to the pole using a ring terminal crimp connector of the proper size.

23-1.16 TESTING

Testing shall conform to the provisions in Section 86-2.14, "Testing" of the Standard Specifications and these Special Provisions.

When video vehicle detection equipment is not supplied by the City of Fresno, the Contractor shall have the equipment shipped from the manufacturer to traffic signal maintenance, 2101 ‘G’ Street, Bldg E, Fresno CA 93706. The equipment will be tested and installed by the City.

When controller equipment is not supplied by the City of Fresno, the Contractor shall provide the controller equipment to Traffic Signal Maintenance, 2101 'G' Street, Building E, Fresno, CA 93706. Ten working days will be allowed for testing and programming of the controller equipment.

Note: Refer to these Specifications regarding Controllers, Cabinets and Ancillary devices.

The controller equipment shall be capable of passing the "self-evaluation program" developed by the State of California Department of Transportation as modified by the City of Fresno.

Should any equipment fail to pass or be rejected as not complying with the Specifications, the Contractor shall remove said equipment within 3 working days after notice of rejection is given. Should the equipment fail to be removed, it may be shipped to the Contractor as his expense.

The Contractor shall allow ten working days for evaluation, testing and programming of all replacement equipment. The ten working days will start when the new equipment is delivered to the City.

The cost of all retesting and evaluation shall be the responsibility of the Contractor.

23-1.17 PAINTING

All paint shall be furnished and applied by the Contractor. Minor touch-up painting on all material whose surface is damaged or not protected from rusting shall be painted as directed by the Engineer. Cold galvanized zinc-rich paint, Military Specifications DOD-P-21035 A, shall be used on all damaged galvanized surfaces.

Reused pedestrian and vehicle signals, visors, and backplates shall be repainted to match new equipment. Painting shall conform to the provisions of Section 86-2.16, "painting", of the standard specifications.

23-1.18 SERVICE

Service shall conform to the provisions in Section 86-2.11, "Service," of the Standard Specifications and these special provisions. Electrical service pedestal installation and wiring shall be as detailed in Public Works Standard Drawing E-15. The underground conduit between the service pedestal and the P.G. & E. point of service shall be galvanized rigid conduit.

23-1.19 SIGNAL FACES AND SIGNAL HEADS

a. Signal faces, signal heads and auxiliary equipment as shown on the plans, and the installation thereof, shall conform to the provisions in Sections 86-4.01, "Vehicle Signal Faces"; 86-4.04, "Backplates"; and 86-4.08, "Signal Mounting Assemblies"; of the Standard Specifications and these Special Provisions.

   All red sections shall be provided with a Light Emitting Diode Kit that conforms to this Section, yellow and green sections will conform to Section 23-1.20 of these Special Provisions.

   Visors on vehicular signals shall be "tunnel" type with open slot at bottom.

   All signal heads, visors, and backplates shall be metallic. Lenses shall be glass except when programmed signals or LED retrofit kits are used. All vehicle signal lenses shall be 12" in diameter.

   Backplates shall be provided for all signal heads except on median mounted lower left turn signal.

   Mounting framework shall consist of 1.5" steel pipe, ductile iron fittings, and bronze terminal compartments. Slipfitter attachments, MAS/MAT, shall be bronze. After installation of the signal mounting framework, any through bolts that extend more than 1" beyond the nut shall be cut to three threads beyond the nut and painted with a zinc rich cold galvanizing compound.

   All set screws exposed to weather shall be zinc, stainless steel or cadmium plated and have square heads.

   When a mast arm is not equipped with a mid-tenon, the Contractor shall provide a City approved Signal Mounting Bracket to install the MAS signal/s. The standard bracket is supplied with 29" mounting bands. Longer lengths are

available and may be needed depending on the particular mast arm used. The bracket shall be installed using the manufacturers detailed installation instructions. Prior to mounting the bracket, the Contractor shall drill a 1" diameter hole in the mast arm corresponding to the desired signal placement. All burrs and sharp edges shall be removed. The area will be cleaned of any oil or drilling compound. A zinc-rich cold galvanizing compound will be applied to the bare metal. A 1" grommet will be installed in the drilled hole to protect the wiring. After the bands are adjusted and tightened, the tenon shall be marked and drilled to accept the MAS through bolt. After mounting and plumbing of the signal, the set screws shall be secured.

b. RED LIGHT EMITTING DIODE KIT

All red signal sections and Ped. hand signals shall be provided with a Light Emitting Diode Kit. The Light Emitting Diode (LED) kit shall replace the reflector, socket, gasket and lens assembly of the incandescent signal face as specified in Section 86-4.07, "Vehicle Signal Faces," of the Specifications. Each retrofit unit shall consist of a convex smooth red polycarbonate ultraviolet stabilized lens, LED circuit board, constant current type power supply, a molded rear housing and EPDM gasket for retaining the assembly in the door of the signal section. The installed unit shall be watertight.

The LED's shall utilize AlInGap technology and shall be the ultra bright type rated for a minimum of 100,000 hours of continuous operation (nominal current and 25 degrees centigrade). The minimum operation range of the unit shall be from 25 to 70 degrees centigrade. The LED emission spectrum shall be 660 nm nominal. The viewing angle of the mounted unit shall not be less than 30 degrees.

The LED signal module shall provide a power factor of 0.90 or better.

Total harmonic distortion (current and voltage) induced into an AC power line by a LED signal module shall not exceed 20 percent.

The operating voltage range of the unit shall be between 92 VAC and 125 VAC. Fluctuations of line voltage shall have minimal effect on the luminous intensity of the indication. The units shall be compatible with Conflict Monitors utilizing Red Monitoring without the installation of any external components. The burnout of any single LED shall not result in the loss of the entire indication.

Nominal power consumption of a 12" ball indication shall be less than 30 watts. Nominal power consumption of a 12" arrow indication shall be less than 20 watts.

The rated luminous output of each LED and the number of LEDs installed in each unit shall be sufficient to meet or exceed the most recent ITE specifications. A statement of compliance from a third party testing facility shall be supplied to the City.

For the 12" ball indication, the minimum number of LEDs shall be 600. For the 12" arrow indication, the minimum number of LEDs shall be 250. Units utilizing an optical component may have fewer LEDs. The LEDs shall be spaced in a uniform pattern throughout the indication.

23-1.20 LIGHT EMITTING DIODE GREEN AND YELLOW SIGNAL MODULE

a. All 12-inch green and yellow circular sections, 8-inch green and yellow circular sections and the 12-inch green and yellow arrow sections shall be provided with Type 1 LED Traffic Signal Modules.

All devices must meet the general specifications of the Transportation Electrical Equipment Specifications (TEES), Chapter 1--General Specifications, as well as these specifications. Incase of conflict, these specification shall govern over the TEES, Chapter 1.

General

Electrical

b. Power Consumption
Maximum power consumption requirements for the are as follows:

GREEN LEDs:

	25°C	74°C
12" circular	12.0 W	12.0 W
8" circular	10.0 W	10.0 W
12" arrow	13.0 W	13.0 W

YELLOW LEDs:

	25°C	74°C
12" circular	22.0 W	25.0 W
8" circular	13.0 W	16.0 W
12" arrow	10.0 W	12.0 W

Operation Voltage
The modules shall operate from a 60 HZ ±3 HZ AC line over a voltage ranging from 95 volts to 135 volts. The fluctuations of line voltage shall have no visible effect on the luminous intensity of the indications.

c. Operating voltage of the modules shall be 120 VAC. All parameters shall measured at this voltage.

d. Power Factor
The LED signal module shall have a power factor of 0.90 or greater.

e. THD

Total harmonic distortion (current and voltage) induced into an AC power line by a LED signal module shall not exceed 20 percent.

f. Surge Suppression
The signal module on-board circuitry shall include voltage surge protection to withstand high-repetition noise transients as stated in Section 2.1.6 of NEMA Standard TS-2, 1992.

g. The LED circuitry shall prevent perceptible flicker to the unaided eye over the voltage range specified above.

h. All wiring and terminal blocks shall meet the requirements of Section 13.02 of the ITE Publication: Equipment and Material Standards.

i. The modules shall be operationally compatible with currently used controller assemblies (solid state load switches, flashers, and conflict monitors). Review TEES Chapters 3 and 6 for specifications on these devices.

j. The modules and associated on-board circuitry must meet Federal Communications Commission (FCC) Title 47, SubPart B, Section 15 regulations concerning the emission of electronic noise.

k. Photometric Requirements

l. The minimum initial luminous intensity values for the modules shall be as defined in VTCSH Part 2, Section 4.1 at 25°C.

The modules shall meet or exceed 85 percent of the standard light output values found in the ITE publication: Equipment and Material Standards, VTCSH Part 2, throughout the useful life based on normal use in a traffic signal operation over the operating temperature range.

m. The measured chromaticity coordinates of the modules shall conform to the chromaticity requirements of VTCSH Part 2, Section 4.2, throughout the useful life over the operating temperature range.

n. Physical and Mechanical Requirements

LED traffic signal modules shall be designed as retrofit replacements for existing optical units of signal indications and shall not require special tools for installation. Type 1 modules shall be installed.

o. Environmental Requirements

p. The LED signal module shall be rated for use in the operating temperature range of -40°C (-40°F) to +74°C (+165°F). The modules shall meet all specifications throughout this range.

q. The LED signal module shall be protected against dust and moisture intrusion per the requirements of NEMA Standard 250-1991 for Type 4 enclosures to protect all internal components.

r. Construction

s. The LED signal module shall be a single, self-contained device, not requiring on-site assembly for installation into an existing traffic signal housing. The power supply for the module shall be integral to the unit.

t. The circuit board and power supply shall be contained inside the module. Circuit boards shall conform to Chapter 1, Section 6 of the "Transportation Electrical Equipment Specifications".

u. The assembly and manufacturing process for the LED signal assembly shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration from high winds and other sources.

v. Materials

w. Material used for the lens and signal module construction shall conform to ASTM specifications for the materials.

x. Enclosures containing either the power supply or electronic components of the signal module shall be made of UL94VO flame retardant materials. The lens of the signal module is excluded from this requirement.

y. Module Identification

z. Each module shall have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked on the back of the module.

a2. The following operating characteristics shall be permanently marked on the back of the module: rated voltage and rated power in Watts and Volt-Ampere.

b2. If a specific mounting orientation is required, each module shall have prominent and permanent marking(s) for correct indexing and orientation within a signal housing. The markings shall consist of an up arrow, or the word "UP" or "TOP".

c2. Type 1 Traffic Signal Module
The following specification requirements apply to the Type 1 module only. All general specifications apply unless specifically superceded in this section.

d2. Type 1 modules can be manufactured under this specification for the following faces:

e2. 12" green and 12" yellow circular

f2. 8" green and 8" yellow circular

g2. 12" green and 12" yellow arrow

h2. Physical and Mechanical Requirements

i2. The module shall fit into existing traffic signal section housings built to the specifications detailed in ITE Publication: Equipment and Material Standards, "Vehicle Traffic Control Signal Heads", with the reflector and lamp socket remaining in place, and without modification to the housing.

j2. Each Type 1 module shall be designed to be installed in the doorframe of a standard traffic signal housing. The Type 1 module shall be sealed in the doorframe with a one-piece EPDM (ethylene propylene rubber) gasket.

k2. The maximum weight of a Type 1 module shall be 1.8 kg (4 lbs.).

l2. Construction

m2. Each Type 1 module shall be a sealed unit to include all parts necessary for operation (a printed circuit board, power supply, a green/yellow lens and gasket, etc.), and shall be weather proof after installation and connection.

n2. Conductors
Two secured, color coded, 914 mm (36 in) long 600 V, 20 AWG minimum, jacketed wires, conforming to the National Electric Code, rated for service at +105°C, are to be provided for electrical connection for each Type 1 LED signal module. Conductors for Type 1 modules shall be 1-m in length, with quick disconnect terminals attached and shall conform to Section 86-4.01C, "Electrical Components," of the Standard Specifications.

o2. If specified in the purchased order, the module will be equipped with an adapter that will screw into the medium base, lamp socket. The adapter shall be able to accept the quick disconnect terminals at the end of the conductors for the module. The electrical contacts of the adapter shall be made of brass.

p2. Lens

q2. The lens of the Type 1 module shall be integral to the unit, shall be convex with a smooth outer surface and made of plastic or of glass.

r2. The lens may be tinted or may use transparent film or materials with similar characteristics to enhance ON/OFF contrasts.

s2. The use of tinting or other materials to enhance ON/OFF contrasts shall not affect chromaticity and shall be uniform across the face of the lens.

t2. The LED signal module lens shall be UV stabilized and shall be capable of withstanding ultraviolet (direct sunlight) exposure for a minimum period of 48 months without exhibiting evidence of deterioration.

u2. If a polymeric lens is used, a surface coating or chemical surface treatment shall be used to provide front surface abrasion resistance.

v2. 12" Green and Yellow Arrow
The following specification requirements apply to the 12" arrow module only. All general specifications apply unless specifically superceded in this section.

w2. The green and yellow arrow module shall meet specifications stated in the VTCSH Section 9.00 for arrow lenses.

x2. The LEDs shall be spread evenly across the illuminated portion of the arrow area

y2. Each module shall provide an average luminous intensity of at least 5,500 candela/m^2 throughout the useful life over the operating temperature range. Arrow modules shall be tested as per California Test 3001.

z2. Quality Assurance

a3. The modules shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of The modules built to meet this specification, and a documented process of how problems are to be resolved.

b3. QA process and test results documentation shall be kept on file for a minimum period of seven years.

c3. LED signal module designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.

d3. Design Qualification Testing

e3. Design Qualification Testing shall be performed by the manufacturer or an independent testing lab hired by the manufacturer on new LED module designs, and when a major design change has been implemented on an existing design. A major design change is defined as a design change (electrical or physical) which changes any of the performance characteristics of the module, results in a different circuit configuration for the power supply, or changes the layout of the individual LED's in the module.

f3. A quantity of two units for each design shall be submitted for Design Qualification Testing.

g3. Test units shall be submitted to Caltrans after the manufacturer's testing is complete.

h3. Manufacturer's testing data shall be submitted with test units for Caltrans verification of Design Qualification Testing data.

i3. Burn In.
The sample modules shall be energized for a minimum of 24 hours, at 100 percent on-time duty cycle, at a temperature of +74°C (+165°F) before performing any design qualification testing.

j3. Any failure of the module, which renders the unit non-compliant with the specification after burn-in, shall be cause for rejection.

k3. For Design Qualification Testing, all specifications will be measured including, but not limited to:

l3. Rated Initial Luminous Intensity.
Measured over the operating temperature range.

m3. Chromaticity (Color).
Measured over the operating temperature range.

n3. Electrical.
All specified parameters shall be measured and used for quality comparison of production quality assurance on production modules. (rated power, etc)

o3. Equipment Compatibility.
Modules shall be tested for compatibility with the controller unit, conflict monitor, and load switch. Each signal module shall be connected to the output of a standard load switch connected to an AC voltage supply between the values of 95 and 135 VAC with the input to the load switch in the "off" position. The AC voltage developed across each LED signal module so connected shall not exceed 10 Vrms as the input AC voltage is varied from 95 Vrms to 135 Vrms.

p3. Mechanical vibration testing shall be as per MIL-STD-883, Test Method 2007, using 3 four minute cycles along each x, y, and z axis, at a force of 2.5 Gs, with a frequency sweep from 2 HZ to 120 HZ. The loosening of the lens, of any internal components, or other physical damage shall be cause for rejection.

q3. Temperature cycling shall be performed as per MIL-STD-883, Test method 1010. The temperature range shall be per "Environmental Requirements". A minimum of 20 cycles shall be performed with a 30 minute transfer time between temperature extremes and a 30 minute dwell time at each temperature. Module(s) being tested shall be energized and functioning throughout the duration of the test. Failure of a module to function properly or any evidence of cracking of the module lens or housing after temperature cycling shall be cause for rejection.

r3. Moisture resistance testing shall be performed on all modules mounted in a standard type "A" pedestrian housing per NEMA Standard 250-1991 for Type 4 enclosures. Any evidence of internal moisture after testing shall be cause for rejection.

s3. Production Quality Control Testing.

t3. The following Production Quality Assurance tests shall be performed on each new module prior to shipment. Failure to meet requirements of any of these tests shall be cause for rejection. Test results shall be retained by the manufacturer for seven years.

u3. Burn-in period shall consist of each signal module being energized at rated voltage for a 30 minute stabilization period before the measurement is made.

v3. Each module shall be tested for rated initial intensity after burn-in.

w3. A single point measurement, with a correlation to the intensity requirements of Section 1.04 of the VTCSH for circular modules, may be used.

x3. The ambient temperature for this measurement shall be +25°C (+77°F).

y3. Each module not meeting minimum luminous intensity requirements per Table 1

of VTCSH for circular modules, 11,000 cd/m^2 for arrow modules, or 3,750 cd/m^2 for pedestrian modules shall be cause for rejection.

z3. Each module shall be tested for required power factor after burn-in.

a4. Each module shall be measured for current flow in amperes after burn-in. The measured current values shall be compared against rated values resulting from design qualification measurements under "Design Qualification Testing". The current flow shall not exceed the rated value.

b4. Each module shall be visually inspected for any exterior physical damage or assembly anomalies. Careful attention shall be paid to the surface of the lens to ensure there are no scratches (abrasions), cracks, chips, discoloration, or other defects. Any such defect shall be cause for rejection.

c4. Caltrans Quality Assurance Testing. (random sample testing)

d4. Caltrans may perform random sample testing on all shipments.

e4. Random sample testing should be completed within than 30 days after delivery to the specified location on the purchase order.

f4. Circular modules shall be tested according to California Test No. 604, and as described herein.

g4. Pedestrian "upraised hand" shall be tested according to California Test No. 606 and as described herein.

h4. All optical testing shall be performed with the module mounted in a standard traffic signal section or in a standard Type "A" Pedestrian Housing, but without a visor or hood attached to the section or housing.

i4. The number of units tested (sample size) shall be determined by the quantity of each model in the shipment. The sample size shall conform to ANSI/ASQC Z1.4. The Caltrans METS shall determine the sampling parameters to be used for the random sample testing.

j4. All parameters of the specification may be tested on the shipment sample.

k4. Acceptance/Rejection of the shipment shall conform to ANSI/ASQC Z1.4 for random sampled shipments.

k5. Warranty

The manufacturer shall provide a written warranty against defects in materials and workmanship for the modules for a period of 48 months after acceptance of the modules. Replacement modules shall be provided promptly after receipt of modules that have failed at no cost to the State. All warranty documentation shall be given to the TransLab prior to random sample testing.

23-1.21 PEDESTRIAN SIGNALS

Pedestrian signals shall conform to the provisions in Section 86-4.05, "Pedestrian Signal Faces," and 86-4.03, "Signal Mounting Assemblies," of the Standard Specifications and these Special Provisions.

Pedestrian signals shall be Type A. International type symbols shall be used.

All pedestrian signal housings shall be metallic. The lenses and egg crate type visors shall be polycarbonate.

Mounting framework shall consist of 1-1/2" steel pipe, ductile iron fittings and bronze terminal compartments.

Clam shell mounting hardware shall not be used.

After installation of the signal mounting framework, any through bolts that extend more than 1" beyond the nut shall be cut to three threads beyond the nut and painted with a zinc rich cold galvanizing compound.

All set screws exposed to weather shall be zinc or cadmium plated and have square heads.

The signal shall have an LED Hand and White Walking Man retrofit kit installed. The installation shall not require any special tools or the drilling of any holes in the reflector or housing. If existing pedestrian housing will not accommodate an LED retrofit kit, the Contractor shall furnish and install a new pedestrian housing.

Power will be supplied from the medium base lamp socket. The assemblies shall have a positive positioning feature to maintain a consistent spacing and orientation from the lens.

The luminous intensity, quantity and color of the LEDs shall be such that the intent of the current ITE specification for Pedestrian Traffic Control Signal Indications is satisfied.

The unit shall have a maximum power consumption of 15 Watts at 120 VAC. The unit shall operate between 92 VAC and 125 VAC and from 25 to 70 degrees centigrade.

Each assembly shall consist of a minimum of 225 LEDs arranged in minimum of 3 strings. The loss of a single LED shall result in a loss of only that string.

23-1.22 DETECTION

Detectors shall conform to provisions in Section 86-5, "Detectors", of the Standard Specifications and these Special Provisions.

Detector amplifiers are included as part of city-furnished controlling equipment.

PVC encased detector loop wire shall be type 1.

Pavement saw cut detector loop wire shall be type 2.

Loop detector lead-in cable shall be Type "C". Cable shall not be spliced between the termination pull box and the controller terminals.

Loops in adjacent lanes shall be polarized and the loop conductor ends identified as detailed in State Standard Plans, ES-5A note #8 and the 'winding Details'.

Loops locations shall be per attached City of Fresno Standard Drawing No. E-14.

The loop wire when spliced to the lead-in cable shall be insulated using Method 'C' Handcrafted Insulation or by using approved heavy wall shrink tubing. All splices shall be made using uninsulated inline connectors, crimped and soldered.

Resistance: max = 0.5Ω + 0.35Ω/c of DLC.
Insulation: min = 100 meg Ω.

The loop test measurements as detailed in the State Standard Plans, ES-5A note #18, shall be documented on the 'Loop Detector Test Results' form provided in the controller cabinet and a copy is provided on page 155 of these specifications. The form will be signed and dated by the individual performing the tests.

The sealant for filling slots shall be ELASTOMERIC SEALANT or HOT-MELT RUBBERIZED ASPHALT SEALANT , and shall conform to State Standard Specification 86-5.01A (5).

23-1.23 PEDESTRIAN PUSH BUTTONS

Pedestrian push buttons shall conform to the provisions in Section 86-5.02 "Pedestrian Push Buttons" of the Standard Specifications and these special provisions.

Pedestrian push buttons shall meet or exceed Americans With Disabilities Act Accessibility Guidelines (ADAAG) for public rights-of-way as specified in The Federal Register, Vol. 59, No. 117 as printed on Monday June 20, 1994.

Pedestrian push buttons, housing and sign shall be pre-approved by the Engineer.

Pedestrian push buttons shall be Type "B" with sign and housing. Housing shall be metallic and sign shall be international symbol and arrow. Push buttons shall be 2" diameter.

The housing shall be sized to conform closely to the curvature of the pole.

23-1.24 AUDIBLE PEDESTRIAN SIGNAL SPECIFICATION

DESCRIPTION
The Accessible Pedestrian Signal (APS) shall provide both a vibrating arrow button and audible sounds during the WALK interval. During the PED clearance and DON'T WALK interval a locating tone.

Sounds are emitted from the sides of the unit. The weather proof speaker shall be mounted behind a face plate with a vandal resistant screen on the sides. A sunlight visible LED confirms the button has been pushed.

System shall include: Frame with Option "A" sign, ADA compliant push button, mounting hardware, and control unit with the following field selectable options: Locating Tone, Extended Push Activation, an Audible "CUCKOO," or "CHIRP," or "WALK SIGN IS ON" voice message during the walk cycle, selectable times for duration of walk cycle sound, and fixed or automatic volume adjustment of all sounds. Under automatic adjustment the volume of the

locating tone and audible sounds automatically adjust in relation to ambient noise levels.

Additional options available shall include:

-Voice on Location; Custom Message
-Special Voice Messages or Sounds during Walk Cycle
-Braille on Face Plate
-Option B Plate Marking or custom marking

CONTROL UNIT

The control unit shall mount inside ped heads or outside the ped head in a separate enclosure. One control is required for each Push Button Station. The control unit is powered from 120 VAC supplied by the WALK and DON'T WALK wires in the ped head.

POWER SUPPLIED TO VIBRATOR: 15VDC pulsed. Operates during walk interval only.

CONFLICT DETECT: WALK indication is ignored in the event of a WALK/DON'T WALK conflict.

AUDIO AMPLIFIER POWER OUTLET: 10 W RMS into 8 Ω.

VOLUME CONTROL: Onboard trimming potentiometer for overall adjustment. Separate control for Locate Tone.

VOLUME CONTROL AUTOMATIC ADJUSTMENT RANGE: 28 Db MAX.

MICROPHONE FOR AMBIENT NOISE: Approximate frequency range: 170 Hz to 2.3 kHz.

PED PUSH BUTTON INTERFACE: Accepts 12 to 48 V AC/DC imposed by connection to push button in parallel with existing traffic signal controller.

LED OPERATION: The LED lights when button is pushed. Thie LED remains lit until the next walk phase.

BUTTON TONE: A brief "tick" confirms each button push.

DIP SWITCH SELECTION OPTIONS: Chirp, Cuckoo, Walk Message, selectable walk sound duration, fixed or auto volume of locate tone, Location Message if available, Extended Push of Triggering, Locating Tone.

AUDIBLE LOCATING TONE: 880 Hz plus harmonic, 0.1 second duration, 1 second interval. Operates during ped clearance and don't walk interval.

AUDIBLE CHIRP SOUND: From 2700 Hz to 1700 Hz .2 second duration, 1 second interval, on only during walk intervals.

AUDIBLE CUCKOO SOUND: 1250 Hz and 1000 Hz .6 second duration, 1.8 second interval, on only during walk interval.

PED POLE UNIT

VIBRATOR POWER: 15 VDC pulsed.

SPEAKER: 8W 15 W MAX, weather proff

TEMPERATURE RANGE: -40°C to +105°C.

PUSH BUTTON: ADA compliant, connects to control unit in parallel with traffic signal controller connection.

LED: Sunlight visible, red.

CONSTRUCTION:

FRAME: Aluminum, powder coated.
FACE PLATE: Aluminum, powder coated, ink marking.
ARROW PUSH BUTTON: Aluminum, hard anodized, powder coated.

23-1.25 EMERGENCY VEHICLE PRIORITY CONTROL SYSTEM

The priority control system shall offer the capability of identifying two levels of priority vehicles at signalized intersections and one level of probe vehicle. High priority for emergency vehicles and low priority for other authorized users will request the traffic signal controller to advance to and/or hold a desired traffic signal display selected from phases normally available. A Probe Vehicle Mode must be available for traffic engineering, run time analysis and response time data gathering. The probe vehicle mode will not preempt the traffic signal. The Probe Mode will record of the probe vehicle's presence at a Priority Controlled intersection. The system will only allow users with flash rates of 14.0359Hz +/-0.05% for high priority and 9.63855Hz +/-0.05% for low priority activation of the system. The system shall also be capable of identifying up to 10,000 individual vehicles by the coded light signal of the vehicle emitter for security and vehicle logging.

The system will have non-authorized vehicle control with the capability of only allowing use of the system to authorized users with valid identification codes. The system must be fully compatible with existing vehicle emitters currently installed on city owned fire apparatus, and city owned signalized traffic signals, as well as contractually obligated mutual aid providers.

The system will record up to 1000 activations, on a continuous basis. The latest preemption will replace the oldest preemption. The system must record the date and time of the preemption, the duration of the preemption, the direction from which the call was received, the vehicle identification number (class and ID), intersection name, log entry number, priority of vehicle, final green signal phase, time spent in final greens, duration of call, and recording of the actual traffic controller green indications. Further, the system must record approximate distance of each emitter recorded during last moment of detection. This data is to be recorded in the phase selector located inside the cabinet. Information to be easily accessible via RS232 port and software. The phase selector shall also have the capability to assign a relative priority to a call request within high or low priority based on the received vehicle ID class.

The system shall offer automated signal intensity threshold settings. Activation range to be set by downloading a code through the software and by using a combination of the software and a special range setting emitter. The system range shall be capable of precise settings using 1200 increments; and actuating between 100 feet and up to 2500 feet passage of 8 separate emergency vehicles, individually approaching the test intersection. Each equipped emergency vehicle will be required to activate the test intersection at 1800 feet with a variance of 100 (+-) feet. The system must be able to set separate ranges on any detector; one for low priority and one for high priority.

The system will be a matched component system with all components from one manufacturer consisting of:

- A Data-Encoded Emitter. The data-encoded emitter will trigger the system. It will send the infrared signal to the detector. It will be located on the priority or probe vehicle.
- A Phase Selector to be located in the controller cabinet with green sense harness wired into the traffic controller per manufacturer specifications.
- Detector cable with four conductors yellow, blue, orange and bare.
- This system will offer three different types of vehicle detectors:
  - One that is single channel/single direction
  - One that is single channel/two directions
  - One that is two channels/two directions

The system shall offer the capability of detector diagnostics through connecting a lap top computer to the phase selector and reading electrical line noise between the traffic signal cabinet and detector mounted in the intersection. System must display information, such as optical noise levels, so as to confirm proper operation of detector and therefore reduce inspection time and effort.

All EVP system equipment submitted to the City of Fresno must include a certificate of product liability insurance protection of at least $5,000,000.00.

23-1.26 LUMINAIRES

Luminaires shall conform to the provisions in Section 86-6.01, "High-Intensity- Discharge Luminaires," of the Standard Specifications and these Special Provisions.

Luminaires shall have built-in high power factor reactor ballast. All Luminaires shall be furnished with high pressure sodium (HPS) lamps, wattage indicated on Equipment Schedule of plans.

Luminaire conductors from pull box adjacent to luminaire to luminaire shall be #10 stranded type THWN. A 5-amp KTK fuse and a TRON HEB type fuse holder will be installed in the circuit at the pole hand-hold.

Sockets shall be positioned for Type III medium cut off light distribution.

After installation and plumbing of the light , the luminaire shall be leveled on both the long and transverse axis by use of spirit level.

If the service pedestal is equipped with a lighting contactor and no master photo control is installed, the Contractor shall install one atop the traffic signal mast arm pole adjacent to the service pedestal or atop the nearest streetlight pole. The master photo control shall be wired back to the service pedestal using three #12 AWG stranded copper wires color matched to the PEC. The PEC will be mounted using hardware manufactured for that purpose or fabricated and approved by the Electrical Superintendent.

All streetlights and safety lights fed from a pedestal equipped with a contactor shall be switched by that contactor, and their PEC’s replaced with shorting caps.

The street light numbers will be installed on the poles using minimum 2 1/2" high numerals. Numbers shall be stenciled or use adhesive backed numbers suitable for outdoor use. The numbers shall be black on a contrasting background.

23-1.27 BARRIER POSTS

Will not be used on this project.

23-1.28 SIGNAL TURN-ON REQUIREMENTS

The following items are the responsibility of the Contractor and must be completed to the satisfaction of the City prior to signal turn-on of new or relocated equipment.

1. The Traffic Engineer must be notified in writing, seven (7) working days in advance of proposed turn-on.

2. All wiring shall have passed the test for shorts and continuity. Detector loops shall have been "Meggered" and meet Specifications.

3. All "field" connections shall be made and verified, including the pedestrian push buttons and the vehicular and pedestrian signal heads.

4. All signal heads shall be properly aimed as directed by the Engineer.

5. All signal poles and heads shall have been in place a minimum of seven (7) days.

6. All auxiliary functions (e.g., safety lights, etc.) shall be operational.

7. The "service" shall be complete, including the utility company meter.

When all of the above are complete and the intersection ready for turn-on, the Contractor shall notify the engineer. The engineer will then arrange with the electrical superintendent to meet with the Contractor at the job site to perform an initial inspection of the installation. If satisfactory, the signal may be placed in operation. Any items needed additional work or correction will be listed and that list provided to Construction Management and the Contractor. Construction Management will insure that these items are corrected as needed.

The Contractor is cautioned not to attempt turn-on prematurely. Time spent by the electrical superintendent at the job site in excess of two hours due to work not completed by the Contractor prior to turn-on will be paid by the Contractor.

23-1.29 TRAFFIC CONTROL

Traffic control shall be provided in accordance with State of California, "Manual of Traffic Controls," latest edition.

A traffic control shall be provided in accordance with State of California, “Manual of Traffic Controls, “latest edition.

Payment shall be included in lump sum bid for signals and lighting.

23-1.30 PAYMENT

Payment for new signals, lighting and modifications shall conform to the provisions in Section 86-8, "Payment," of the Standard Specifications and these Special Provisions.

The contract bid price shall include traffic signal and safety lighting and no additional payment will be allowed.

SECTION 23-2 CITY OF FRESNO SPECIFICATIONS

TRAFFIC SIGNAL CONTROLLERS, CABINETS AND ANCILLARY DEVICES

TECHNICAL SPECIFICATIONS

23-2.1 GENERAL

a) It is the purpose and intent of these Specifications to describe the minimum requirements for traffic signal controllers, cabinets, and other ancillary devices to be used by the Traffic Engineering, Street Maintenance - Traffic Signals & Streetlights Divisions, of the Public Works Department within the City of Fresno.

b) All items not specifically mentioned which are required for a complete 8 phase unit shall be included in the unit.

c) All equipment and accessories to be furnished must be new and in current production. All products shall conform in design, strength, quality of material and workmanship to current industry standards.

d) Each item shall be accompanied by two (2 sets) of the manufacturer's illustrated descriptive literature and specifications. A copy of the manufacturer's standard warranty shall also be attached to the equipment.

All equipment and accessories shall comply with regulations of the Federal Occupational Safety and Health Administration (OSHA) and/or the California Occupational Safety and Health Administration (Cal/OSHA), whichever is more restrictive.

Title 49, Code of Federal Regulations, Chapter III, Federal Highway Administration Department of Transportation.

State of California Vehicle Code.

State of California,(Caltrans) the most recent Traffic Signal Control Equipment Specifications, and all subsequent addenda.

Technical Specifications:

All material and equipment supplied must comply with the latest plans and specifications of the State

of California, Department of Transportation (CALTRANS), except for those exceptions allowed herein, and must be manufactured by companies on their Qualified Products List (QPL). The most recent QPL as promulgated by Caltrans will be the list used to determine the qualification of the products offered. Any submittal with any products not on the QPL will be rejected. Any changes occurring in subsequent QPL's shall be considered in effect on all subsequent orders.

Model 170E Controllers:

The Model 170E controllers shall be supplied with a Model 412C Program Module. The 412C Program Module will be configured for “Memory select 4", per Paragraph 3.2.2 of the Traffic Signal Control Equipment Specification dated January 1989 (CALTRANS).

332A Cabinet:

Meets all Caltrans and FHWA requirements. The Models 332A Cabinets shall be anodized aluminum (0.125" thick).

The 332A cabinet suppliers shall be qualified 332A suppliers.

The cabinet shall include the power supply, two Model 204 flashers, all necessary relays, the Conflict Monitor, a red interface adapter, a thermostatically controlled fan, a door switch operated fluorescent light, a slide out shelf/drawer storage unit and four anchor bolts. All crimp type terminals between the Lower Input Panel and the Input file shall be soldered. For matching purposes the City will accept the Corbin 3-point locking system lock, which shall be keyed alike to the City specifications, (No Substitutions). All 15 amp breakers and 20 amp breakers shall be short delay, for example Potter & Brumfield Curve 3 or Carling Switch, Inc., Curve 22.

200 Load Switch:

The load switch is a tri-pack, modular, solid state relay designed specifically to meet NEMA specifications, as well as California and New York Model 200 specifications. Each load switch contains 3 individually replaceable modules that are inclosed in a dust resistant metal enclosure. The load switch intermates with the Model 332 cabinet output file as well as with any NEMA loadbay. Quantities shall be supplied for a eight (8) phase operation.

222 Two Channel Loop Monitor:

The loop inputs incorporate lightening and transient protection devices and the loop oscillator circuitry is transformer isolated. The lightening protection will withstand the discharge of a 10uF capacitor charged to 2,000V across the loop inputs or between any loop input and earth ground. The transformer isolation allows operation with loops which are grounded at a single point. Quantities shall be supplied for a eight (8) phase operation.

242 Two-Channel D.C. Isolator:

Two-channel dual change (DC) Isolator is designed to comply with California Department of Transportation (Caltran) Model 242 specifications. Each channel of the D.C. Isolator shall present a true signal (ground closure) at the input voltage of less than 8 VDC, for longer than 5 milliseconds. The D.C. Isolator intermates with the model 332 cabinet input file. Quantities shall be supplied for a eight (8) phase operation.

204 Flasher Unit:

The flasher unit intermates with the model 332 cabinet. It has a dual circuit flasher designed for the traffic control industry, specifically to meet the California Department of Transportation Model 204 specifications. This unit is rated up to a 15 A per circuit. The flash rate is 56.25 flashes per minute

and does not vary due to voltage or temperature variations. Two shall be required installed at time of delivery.

Conflict Monitor 210E Series + features:

The Conflict/Voltage Signal Monitor unit is exempt from QPL qualification and shall be a Model 210 with + features, as manufactured by Solid State Devices or Eberle Designs Inc. The interface for the conflict/voltage signal monitor shall be installed in the cabinet output file at the factory per the conflict/voltage signal monitor manufacturer's instructions. The unused channel programming of the interface shall be configured for full quad 8 phase operation. Modification of the programming shall be possible without the use of any tools. For conflict monitors ordered as individual units, the interface provided shall be the monitor manufacturer's generic interface complete with all cables and hardware necessary to provide complete operation of the monitor. Conflict Monitor shall be installed at time of delivery.

Testing:

Prior to installation the Contractor must be able to deliver to the City of Fresno facilities for testing and inspection all equipment. The controllers, cabinets and ancillary devices will be evaluated for performance. The Model 170E controllers will be tested to 160°F and must pass the City diagnostic test. The City diagnostic is essentially identical to CALTRANS Diagnostic and Acceptance Test Program, version 2.4, dated 1/04/95. The purposeof the testing is to ensure that the equipment will work in the field, and as stated above meet all requirements.

If a PAL, EPROM, or ROM devise is used in address decoding and timing algorithms, the devise code listing together with data sheets and any specific coding requirements shall be included in unit or module documentation. The devise shall be delivered in the quantity of one devise per 12 units or fraction thereof in addition to those used to make the unit functional.

The City of Fresno reserves the right during the testing process to contact the Contractor for additional information. Any equipment found to be defective will be rejected and shall be replaced by the Contractor within thirty (30) calendar days of the date of notification by the City and at no cost to the City. Testing of replacement equipment will be at the Contractor’s expense. Any equipment not approved by the City because of testing failure shall be picked up by the Contractor at the Contractor’s expense. The Contractor shall have forty eight (48) hours to remove equipment failures after notification by the Traffic Signal Supervisor. The City will not accept or have installed any rejected equipment.

Approved Manufacturer Equipment and Brands

Controllers:

Safetran Traffic Systems 412C
Dynamic Traffic Systems, Inc 412C

Cabinets and Ancillary Devices

Precision Design Company (PDC)
Eberle Design Inc. (EDI)
Solid State Devices
McCain Traffic Supply
Traffic Safety Supply

LOOP DETECTOR TEST RESULTS

INTERSECTION:_____

TESTED BY:_____ **DATE:**_____

DET #	PHASE	SLOT	MOVEMENT	TB/CONN	RESISTANCE	INSULATION

INSTRUCTIONS FOR ENTRIES

DET #: Reference Designation From Plan (Example=8A)
PHASE: Associated Controller Phase (Example=6)
SLOT: Input File Location of Amplifier (Example=14U)
MOVEMENT: Detected Traffic Movement (Example=NB/SBLT/EBRT)
TB/CONN: Point of Connection to Input TB (Example=TB5-1&2)
RESISTANCE: Ohmmeter Reading In Ohms (MAX=0.5 + 0.35/c of DLC)
INSULATION: Megger Reading In Megohms (MIN=100)

LOOPDECTOR_FORM.WPD 8/28/2001 eg/odc

SECTION 23-3 CITY OF FRESNO SPECIFICATIONS FOR STREET LIGHTING

23-3.1 DEFINITIONS

Whenever in the Special Provisions and other contract documents the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as provided below:

Electrical Superintendent: City of Fresno Traffic Signal/Streetlight Supervisor or his representative.

Engineer: Construction Management Engineer or his representative.

Traffic Engineer: City Traffic Engineer or his representative.

Standard Specifications: State of California Department of Transportation, Standard Specifications, latest edition.

Street Lighting Poles/Standards: State of California, Department of Transportation, Standard Specifications, 1997 Edition. State Type15 Light Standard equals City E-1 Light Standard (113km rating/70 mph rating)

23-3.2 GENERAL

Furnishing and installing streetlights and payment therefore shall conform to the provisions in Section 86, "Signals and Lighting," of the State of California, Department of Transportation Standard Specifications and the Standard Plans, most recent version, the City of Fresno Public Works Standard Drawings; E-1 through E-25 as applicable; the Special Provisions and the Plans.

Streetlight work is to be performed at the locations shown on the plans.

Existing electrical systems, or approved temporary replacements thereof, shall be kept in effective operation during the progress of the work, except when shutdown is permitted.

Work or equipment not specified or shown on the plans which is necessary for the proper operation of the work in this section shall be provided and installed at no additional cost to the City.

The locations of foundations, poles, services, pull boxes and other appurtenances shown on the plans are approximate. Exact locations and grades will be established as necessary by either the Traffic Engineer and/or engineer in the field.

23-3.3 MATERIALS

Attention is directed to Section 6, "Control of Materials," of the Standard Specifications and these Special Provisions.

All materials required to complete the work under this contract shall be furnished by the Contractor, except as noted in the following paragraph 4.00, "City-Furnished Materials."

The materials furnished and used shall be new, except such used materials as may be specifically provided for on the plans.

All work and materials shall be in full accordance with the latest rules and regulations of the National Board of Fire Underwriters, and local ordinance or State laws, the State of California Industrial Accident Commission's Safety Orders, and Regulations of the Pacific Gas and Electric Company pertaining to Service equipment and installations thereof. All work shall comply with Fresno City Electrical Ordinances and National Electrical Manufacturer's Association Standards and all regulations and codes as stated in Section 86-1.02 "Regulations and Codes" of the Standard Specifications. Nothing in these plans and specifications shall be construed to permit work not complying with these codes.

23-3.4 CITY-FURNISHED MATERIALS

Attention is directed to Section 6-1.02, "State-Furnished Material," of the Standard Specifications and these Special Provisions.

Unless otherwise provided in this section, the Contractor shall submit a written request to the Traffic Engineer for the delivery of City-furnished material at least 15 days in advance of the date of its intended use. The request shall state the quantity and type of each material.

The following items will be City-furnished materials:

NONE

The Contractor shall pick up the City-furnished equipment from the City of Fresno, Street Maintenance Division, 2101 'G' Street, Bldg. 'E', Fresno, CA. Contact the Electrical Superintendent at 498-1517 at least two working days prior to picking up the material. The Contractor is responsible for providing adequate loading means.

23-3.5 EQUIPMENT LIST

Equipment list and drawing shall conform to the provisions in Section 86-1.04 and these Special Provisions.

All equipment and materials that the Contractor proposes to install shall conform to these specifications and the contract plans. A list of substitute equipment and/or material, along with

a written descriptive summary, describing the functions of the components which the Contractor proposes to install shall be submitted along with his bid proposal. The list shall be complete as to the name of the manufacturer, size and identifying number of each item. The list shall be supplemented by such other data as may be required.

In all cases, the judgement of the Traffic Signal & Streetlight Superintendent shall be final as to whether substitute equipment and/or material recommended by the Contractor conforms to the intent of these specifications and is acceptable for use.

23-3.6 WARRANTIES, GUARANTEES AND INSTRUCTION SHEETS

Warranties, guarantees and instruction sheets shall conform to the provisions in Section 86-1.05, "Warranties, Guarantees and Instruction Sheets," of the Standard Specifications and these Special Provisions.

All equipment furnished shall be guaranteed to the City by the manufacturers for a period of not less than one (1) year, unless otherwise indicated, following the date of acceptance of such equipment. If any part (or parts) is (are) found to be defective in materials or workmanship within the one-year period, and it is determined by the Electrical Superintendent, or by an authorized manufacturer's representative that said part (or parts) cannot be repaired on the site, the manufacturer shall provide a replacement part (or parts) of equal kind and/or type during the repair period and shall be responsible for the removal, handling, repair or replacement and reinstallation of the part (or parts) until such time as the streetlighting equipment, is functioning as specified and as intended herein; the repair period shall in no event exceed 72 hours, including acquisition of parts.

The one-year guarantee on the repaired or replaced parts shall again commence with the date of reassembly of the system.

All work done by the Contractor shall be guaranteed in writing to the Engineer for the 12 months from the date of acceptance.

23-3.7 MAINTAINING EXISTING AND TEMPORARY ELECTRICAL SYSTEMS

The Contractor shall notify the Engineer at least one full working day (not less than 24 hours) prior to the shutdown of any streetlighting system. The Contractor may use temporary splices and wiring as approved by the Engineer to maintain existing and temporary streetlighting systems.

23-3.8 SCHEDULING OF WORK

Scheduling of work shall conform to the provisions in Section 86-1.07, "Scheduling of Work" and these special provisions.

The Contractor shall notify the Engineer at least one working day in advance of any electrical work and also at least one working day in advance of any work done intermittently to facilitate inspection.

23-3.9 FOUNDATIONS

Foundations shall conform to the provision in Section 86-2.03, "Foundations," of the Standard Specifications and these Special Provisions.

Portland cement concrete shall conform to Section 90-10, "Minor Concrete," of the Standard Specifications and shall contain not less than 470 pounds of cement per cubic yard.

Foundation concrete shall be placed in a single pour except that pouring of the top six (6) inches may be postponed when prior approval has been obtained.

No utilities shall be permitted to run through a foundation.

Foundations shall be poured against undisturbed earth where practicable. The exposed portion shall be formed and finished to present a neat appearance. Where obstructions or other conditions prevent construction of planned foundations, the Contractor shall construct an effective foundation satisfactory to the Engineer.

The bottom of concrete foundations shall rest on firm ground. When placing the foundations, the Contractor shall place all conduit ends in their proper position, at the correct heights and shall securely hold them in position during the pouring of concrete. The conduit ends shall be capped before any concrete is poured.

Both forms and earth to be in contact with foundations shall be thoroughly moistened before placing concrete.

Anchor bolts shall be galvanized and shall extend above the finished base as needed to insure a minimum extension above the top nut of 3 threads. The maximum extension above the top nut is 1 inch. The distance below the base plate allowed for the leveling shall not be less than 1.5 times nor less than 2 times the thickness of the leveling nut. Each bolt shall be supplied with 2 nuts and 2 flat washers to facilitate leveling. The anchor bolts and conduits shall be held in place by means of a template until the concrete sets.

Poles shall not be erected until the foundation concrete has set at least seven days and shall be plumbed as directed by the Engineer. The top of concrete foundations shall be finished relative to curb or sidewalk grade as shown on the plans or as directed by the Engineer.

When grouting the base of the pole, the Contractor shall take care not to allow grout to enter or foul the conduit within the foundation.

Locations shown on the plans are schematic.

23-3.10 POLES

Poles shall conform to the provisions in Section 86-2.04, "Standard, Steel Pedestals and Posts," of the Standard Specifications and these Special Provisions.

Embedded Steel poles shall conform to PG&E specifications for pole type 35-7274.

If relocation of utilities is required, immediate notification shall be given to the appropriate utility company by the Contractor.

The Contractor may install all underground electrical components, including foundations at the site of the project; however, no streetlight poles shall be erected until underground conduit and wiring are in place.

All nuts, washers, screws and other post hardware shall be galvanized.

23-3.11 CONDUIT

Conduit shall conform to the provisions in Section 86-2.05, "Conduit," of the Standard Specifications and these Special Provisions.

Nonmetallic-type conduit may be used on minor/local and major streets as shown on the plans. All street crossings using nonmetallic conduit shall be Schedule 80 conduit.

Rigid Conduit shall conform to Article 346 of the National Electrical Code. All conduit and fittings shall be hot dip galvanized. Each length shall bear the UL label. Installation shall conform to appropriate Articles of the Code. All conduit ends shall be threaded and joined with approved fittings. The use of threadless or set-screw type fittings is not allowed.

All couplings shall be tightened to provide a good electrical and mechanical connection throughout the entire length of the conduit run.

Conduit threads cut in the field and damaged conduit surfaces on metal conduit shall be thoroughly painted with zinc rich paint conforming to Military Specifications DOD-P-21023A.

All conduit ends shall be threaded and capped with standard conduit caps until wiring is started. When the caps are removed the threaded ends shall be provided with approved insulated hot dipped galvanized malleable iron bushings. All bushings in service pedestals and pull boxes shall have lay-in style copper lugs provided for bonding.

The size of conduit used shall be as shown on the plans.

It shall be the privilege of the Contractor, at his own expense, to use larger size conduit if desired, and where large size conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted.

All conduit shall be laid to a depth of not less than twenty-four inches nor greater than thirty-six inches below the curb grade in the sidewalk areas and from the finished surface in street areas. Conduits in sidewalk areas and parallel to the curb shall not be installed more than twenty-four inches back of curb unless approved by the Engineer.

Conduit shall be placed under existing pavement by approved jacking or boring methods. The pavement shall not be disturbed without the written permission of the engineer and then only in the event insurmountable obstructions are encountered. Excessive use of water, such that pavement might be undermined, or subgrade softened, will not be permitted.

Conduit ends terminating in pole foundations shall extend 2" vertically above the top of the foundation. Conduit in direct buried poles shall extend to within 2" of the bottom of the handhole and may not extend above the lowest part of the handhole opening.

Attention is called to Public Works Standard Drawing E-1 with regard to the requirements of conduit within the foundation. No factory 90 degree bends or fittings in the vertical rise are permitted.

Conduit in pull boxes shall not extend more than two inches inside the box wall. All conduit entering the pull box from the bottom shall be approved by the Engineer. No conduit or utility shall pass through a streetlight foundation or pull box except the conduit which terminates within the foundation or pull box.

After the installation of all conductors the ends of conduits terminating in pull boxes and service pedestals shall be sealed with approved duct seal material.

Where shown on the plans, conduit will be extended to the limits of the project for future use. The end of such conduits shall be threaded and capped.

In as much as possible, conduit shall be run in a straight line from one pull box or pole to the next maintaining a consistent setback from the curb. Any variation from this requirement shall be approved by the Engineer or Electrical Superintendent.

23-3.12 PULL BOXES

Concrete pull boxes shall conform to the provisions in Section 86-2.06, "Pull Boxes," of the Standard Specifications and these Special Provisions.

All pull boxes shall be #3-1/2 unless otherwise noted on the plans.

All pull boxes shall be installed with extensions.The pull box lid adjacent to PG&E's service pole shall be marked 'PG&E'. All others shall be marked 'Street Light'.

Pull box lids shall not be equipped with hold down bolts.

Attention is directed to Section 86-2.06C, "Installation and Use," where pull boxes, on long runs, shall be installed and spaced at not over 200-foot intervals.

All pull boxes shall be wrapped with building paper prior to backfilling.

Should grout within existing pull-boxes be disturbed by the Contractor, it shall be restored.

23-3.13 CONDUCTORS AND WIRING

Conductors and wiring shall conform to the provisions in Section 86-2.08, "Conductors," and Section 86-2.09, "Wiring," of the Standard Specifications and these Special Provisions.

All wiring and wiring methods shall conform to the provisions of the applicable Codes.

A minimum of three feet of slack in each conductor shall be left at each streetlight standard and in each pull box.

Delete the paragraph under number 5 in Section 86-2.09D "Splicing" which permits splicing of underground conductors.

All circuit conductors shall be stranded copper with THWN insulation and be of the gauge as shown on the plans. All conductors shall have insulation colors appropriate to their use and all applicable codes. The use of colored phase tape is not allowed.

Public Works Standard Drawing E-5 details the field connections of the circuit conductors.

Conductors within the pole shall be #10 awg Type THWN stranded copper.

Splices in single conductor wire shall be limited to the load side of the service and to tap type splices located in pull boxes. These splices shall be made using either split bolts or c-tap connectors. The c-tap shall be properly sized for the wires being joined and installed with the proper tooling. The splice shall be simulated as follows: minimum 2 layers of rubber tape, 1 layer--½ lapped plastic tape, 1 layer friction tape and then coated with an approved electrical sealing compound (Skotchkoate).

Should splices between existing aluminum and new copper conductors be required, the splice shall be made using a split bolt designed for that purpose. The conductors and split bolt shall have an appropriate joint compound, designed to prevent oxidation, liberally applied prior to installation.

23-3.14 FUSED SPLICE CONNECTORS

Each streetlight shall be fused with a 5 amp KTK type fuse installed in a TRON HEB type fuse holder. The fuse and holder shall be located in the pole adjacent to the hand hole. Sufficient slack shall be provided to allow easy changing of the fuse as needed. The fuse holder shall be crimped to the wire and the crimp joints insulated as described above for tap type splices.

At service points other than pedestals, a fuse holder and fuse shall be installed in each current carrying conductors. The fuse holder shall be a TRON HEJ type with an SC fuse; 40 amp for #8 awg wire, 60 amp for #4 or #6 awg wire. The holder shall be crimped to the wire using the proper tooling and insulated as described above for tape type splices.

23-3.15 BONDING AND GROUNDING

Bonding and grounding shall conform to the provisions in Section 86-2.10, "Bonding and Grounding," of the Standard Specifications and these Special Provisions.

Ground will be obtained by installation of a ground rod within the service. This ground rod shall be bonded to all metallic conduits within the service by means of a bare #8 solid copper conductor. The metallic conduits within all pull-boxes shall be bonded in a similar manner.

Within pull-boxes adjacent to streetlight standards, one end of the solid #8 bonding conductor shall be extended to and attached to the standard using the grounding point as furnished.

Within all conduits, a #8 stranded copper conductor with green THWN insulation shall be installed. It shall be connected to the ground rod at the service and connected to all pole grounding connections. Tap splices at pull boxes shall be made using either split bolts or c-taps.

23-3.16 PAINTING

All paint shall be furnished by the Contractor. Minor touch-up painting on all material whose surface has been damaged or not protected from corrosion shall be accomplished as directed by the Engineer. Cold galvanizing zinc-rich paint, MILSPEC DOD-P-21035 A, shall be used on all damaged galvanized surfaces.

23-3.17 SERVICE

The Service shall conform to the provisions in Section 86-2.11, "Service," of the Standard Specifications and these Special Provisions.

All services for multiple streetlight circuits shall be 120/240 volt, 3 wire single phase. This will also be required for installations that have probable expansion adjacent to the current installation. Single street light installations shall be 120 volt 2 wire.

The service pedestal for Street Light installations shall be as detailed in Public Works Standard Drawing E-18.

If designed to feed from a Combination Traffic Signal and Streetlight service pedestal is/shall be as detailed in Public Works Standard Drawing E-15. The Contractor shall be responsible for any modification necessary to existing pedestals not in conformance with the current standard. The Electrical Superintendent shall be contacted for component information as needed.

The underground service if used shall be as detailed in Public Work Standard Drawings E-4 & E-6. The conductors from the service pull box to the PG&E pull box shall be a minimum #6 awg.

23-3.18 LUMINAIRE

The luminaire shall conform to the provisions in Section 86-6.01, "High Pressure Sodium Luminaires," of the Standard Specifications and these Special Provisions.

The luminaires shall be of the 'cobra-head' type equipped with a polycarbonate refractor and Photoelectric Control Socket.

The luminaire ballast shall be designed for 120 volt operation at 70 or 150 watts as shown on the plans and have a high power factor. The starting aid shall be of the 3-wire type.

The luminaire shall be set for a Type III Medium Cut-Off light distribution.

After installation and plumbing of the light standard, the luminaire shall be leveled on both the long and transverse axis by use of a spirit level.

The street light numbers will be installed on the poles in accordance to Public Works Standard Drawing E-25. They shall be stenciled or use adhesive backed numbers suitable for outdoor use. The numbers shall be black on a contrasting background.

23-3.19 PHOTOELECTRIC CONTROL

Photoelectric controls (PEC) shall conform to the provisions in Section 86-6.07 "Photoelectric Controls," of the Standard Specifications and these Special Provisions.

The PEC shall be a quick acting, twist lock, Type IV.

If the service pedestal is equipped with a lighting contactor and no master photo control is installed, the contractor shall install one atop the traffic signal mast arm pole adjacent to the service pedestal or atop the nearest streetlight pole. The master photo control shall be wired back to the service pedestal using three #12 AWG stranded copper wires color matched to the PEC. The PEC will be mounted using hardware manufactured for that purpose or fabricated and approved by the Electrical Superintendent.

All streetlights and safety lights fed from a pedestal equipped with a contactor shall be switched, by that contactor and their PEC’s replaced with shorting caps.

23-3.20 TRAFFIC CONTROL

Traffic control shall be provided in accordance with the State of California, "Manual of Traffic Controls for Construction and Maintenance Work Zones," latest edition. Payment shall be included in the lump sum bid for streetlighting.